

## Zinc Sulphate Induces Sterility in the Cotton Leafworm *Spodoptera littoralis* Boisduval

The toxicity of dietary zinc to various insects was recorded<sup>1,2</sup>. Some zinc salts also induced growth depression and developmental abnormalities in some lepidopterous species<sup>3-5</sup>. In the present study, it has been found for the first time that the neutral salt  $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$  supplemented with the larval diet of *Spodoptera littoralis* induced sterility in the emerged moths. Such effect of neutral salts on the insects has not been recorded before.

**Methods.** The crystalline salt was blended with the artificial diet developed for the cotton leafworm<sup>6</sup> at concentrations 0.1, 0.3 and 0.6%. The diet is mainly composed of dry kidney beans, agar, ascorbic acid, Brewer's yeast, vitamin mixture and mould inhibitors.

hatch, while at 0.1% concentration, 28% of eggs hatched compared with 99.4% in the control group. Male and female moths ensuing from treated larvae copulate normally, since immobile sperms were detected in the spermatheca of the females confined with treated males. Females ensued from larvae treated with 0.3% concentration of the salt mated with untreated males gave a mean egg production of  $70.2 \pm 19.1$  eggs/female (mean of 30 pairs) all of which did not hatch. When treated males ensued from larvae treated with the same concentration were mated to untreated females, the egg production was  $389.4 \pm 18.4$  eggs/female (mean of 30 pairs) and all eggs were sterile.

Data on the effect of zinc sulphate on the development of *Spodoptera littoralis* Boisduval

	Larval diet supplemented with $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$			
	Control	0.1%	0.3%	0.6%
Larval duration (days) $\pm$ S.E.	11.9 $\pm$ 0.03	13.6 $\pm$ 0.06	15.5 $\pm$ 0.18	15.6 $\pm$ 0.30
Pupal duration (days) $\pm$ S.E.	6.9 $\pm$ 0.09	7.4 $\pm$ 0.08	7.6 $\pm$ 0.07	7.6 $\pm$ 0.03
Pupal weight (mg) $\pm$ S.E., Male	241.0 $\pm$ 13.30	250.1 $\pm$ 20.10	232.3 $\pm$ 16.50	154.7 $\pm$ 15.00
Pupal weight (mg) $\pm$ S.E., Female	267.1 $\pm$ 13.20	268.8 $\pm$ 15.00	207.8 $\pm$ 12.40	192.8 $\pm$ 12.00
Emergence (%)	87.4	85.9	79.6	50.0
Mean egg No. per female*	472.4 $\pm$ 19.10	79.4 $\pm$ 34.30	52.7 $\pm$ 21.70	21.3 $\pm$ 5.60
Hatching (%)	99.4	28	0	0

\*30 treated pairs were used in each test (all females laid eggs in all tests).

Rearing was run at 30 °C using 200 newly hatched larvae for each concentration beside the control group. 30 pairs of moths ensued from each treatment were confined singly in 1 litre glass jars provided with leaves of *Nerium oleander* as oviposition sites and fed on 10% honey solution. Duration of developmental stages, emergence, fecundity of moths, hatchability of eggs were observed (Table) and the data were subjected to statistical analysis.

**Results.** The larval development was significantly delayed on supplementing its diet with 0.1–0.6% concentration of the salt and also the larval mortality proportionally increased with the increase of salt concentration. The pupal duration showed no differences in response to treatments, while the weight of the pupae significantly decreased after larval feeding on 0.6% concentration of the salt. The percentage of emergence decreased with the increase of salt concentration but no abnormalities were observed with emerged moths in size or shape.

Larval diet supplemented with 0.1–0.6% of the salt caused a significant reduction in the eggs laid by moths. At 0.3 and 0.6% concentrations, all eggs laid failed to

The foregoing results revealed that the neutral salt  $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$  may have a sterilizing effect on the cotton leafworm *S. littoralis* when supplemented with the diet given to the larvae, without causing abnormalities in the insect behaviour. The accumulated effect of zinc at such sublethal doses may affect the normal development of the reproductive system in either sex.

Further studies on the effect of this salt on the feeding behaviour and growth of the insect are in progress to explain the mechanism involved in sterilization.

**Zusammenfassung.** Eine subletale Konzentration von 0,3% Zinksulfat im Larven-Nährmedium der Baumwolleneule *Spodoptera littoralis* ergibt morphologisch und im Verhalten normale Falter, die jedoch vollkommen steril sind und zudem eine stark reduzierte Fekundität aufweisen.

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